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# Automated Crime Detection and Alert System via Embedded Deep Learning

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**ABSTRACT—** During the last few decades, surveillance cameras have been installed in different locations. Analysis of the information captured using these cameras can play effective roles
in event prediction, online monitoring and goal-driven analysis applications including anomalies and intrusion detection. Nowadays, various Artificial Intelligence techniques have been used to detect anomalies, amongst them convolutional neural networks using deep learning techniques improved the detection accuracy significantly. The goal of this article is to propose a new method based on deep learning techniques for Crime detection in video surveillance cameras. The proposed method has been evaluated in the UCSD dataset, and showed an increase in the accuracy of the Crime detection.

## I. INTRODUCTION

Crime scene detection with the use of unsupervised machine learning techniques is still an open debate in the field of machine learning. Crime means the occurrence of events or behaviors which are unusual, irregular, unexpected and unpredictable and thus different from existing patterns. Detecting anomalies by learning from normal data can have important and different applications. And also, an Crime detection process is completely dependent on the environment, context and Crime scenario. In different scenarios, anomalies will accordingly be different. Existing supervised methods for Crime detection such as simple CNN based methods require labels which are difficult to attain due to the video high dimension information. High dimension of video affects representation and creation of a model. In this paper, Crime detection is based on videos of surveillance cameras. It should be noted that detection in videos is more difficult than in other data since it involves detection methods and also requires video processing as well. The processing of surveillance cameras information in crowded scenes poses serious challenges and difficulties. If this process is online, the complexity will even increase. One of the best approaches for processing this information and consequently achieving the goal-oriented pattern is the use of advanced machine learning techniques such as deep learning approaches. The advantage of these types of processes, which usually have a high dimensional data, can be traced back to the existence of an end-to-end system. End-to-end systems automate feature extraction. One of the main purpose of using deep learning is to extract information from high dimension data

This paper introduces an Crime detection method based on deep learning techniques. The architecture of this method has two main phases which are called train network and detection classifier. The first phase aims for feature extraction and is consisted of five components with a deep structure. The aim of the second phase is detection. This phase is consisted of five deep neural network classifiers and reconstruction network. Each component in detection phase produces a detected class and a score. At last, by these detection classes and scores, the ensemble classifier performs the final detection and announces it. The main contribution of this paper is the use of deep learning techniques in all phases of Crime detection. In other sections of this paper, at first, a brief description and background of video Crime detection based on deep learning methods is provided, at section II, related work is presented, in section III, our proposed new method is described in detail and in the final section evaluations are conducted to demonstrate improvements and advantages of the proposed method in comparison with previous methods

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## II. LITERATURE SURVEY

[1]This paper explores integrating deep learning into CCTV systems to detect crime intentions by identifying weapons like knives and guns. The authors use pre-trained object detection models, specifically YOLO, to recognize weapons in video feeds. The system achieves 79% accuracy, which shows promise for real-world applications. However, challenges like occlusion, poor lighting conditions, and false positives impact performance. The research emphasizes the importance of automated monitoring systems for crime prevention, particularly in urban areas. The study could benefit from further refinement in handling complex scenarios such as crowded settings or unconventional weapon designs. Overall, it sets a foundation for leveraging deep learning in public safety.

[2]This paper proposes a novel system for detecting motion and crime-related objects to predict potential crime intentions. It combines motion detection algorithms and deep learning models like SSD and YOLO. The system is designed for real-time alerts, enabling security personnel to act promptly. Key findings include the system's ability to trigger alarms in restricted areas with a reasonable accuracy rate. However, distinguishing suspicious movements from normal behavior remains a limitation. Future work should focus on enhancing robustness, particularly in complex environments. The study is significant for its contribution to real-time surveillance systems, providing a practical approach to crime prevention.

[3]This paper presents a real-time crime detection framework integrating trustworthy deep learning models to classify suspicious actions and objects. The authors utilize convolutional neural networks (CNNs) and recurrent neural networks (RNNs) to process spatial and temporal data from video feeds. The system demonstrates improved accuracy in identifying weapons and aggressive behaviors, particularly in controlled environments. Key contributions include the incorporation of explainable AI to enhance the reliability of decisions. However, the model's computational requirements make deployment challenging on resource-constrained devices. The paper highlights the need for optimizing deep learning models for real-time applications while maintaining high detection reliability.

[4]This research focuses on developing a real-time crime monitoring system by integrating AI with CCTV technologies. The proposed system utilizes advanced object detection models like Faster R-CNN to identify crime-related activities. The study reports significant success in detecting suspicious actions, achieving high performance in well-lit and clear environments. However, its dependency on high-resolution video limits its effectiveness in scenarios with poor lighting or low-quality cameras. The paper underscores the potential of AI-powered monitoring systems for urban safety but suggests the need for adaptive algorithms capable of functioning in diverse conditions.

[5]The study emphasizes early recognition of armed robberies using distributed deep learning-based surveillance systems. The authors employ models such as YOLO and SSD to detect weapons in crowded and complex environments. A notable feature of this system is its ability to operate on standalone devices, reducing reliance on centralized servers. The system excels in detecting visible weapons but struggles with unconventional weapon designs or occlusions. The paper is a valuable contribution to crime prevention strategies, advocating for edge computing to enhance system scalability and reduce latency.

[6]This paper explores the application of traditional machine learning methods for crime detection in surveillance systems. The authors use feature extraction techniques with classifiers like support vector machines (SVM) and decision trees to identify anomalies in video feeds. While the system offers a cost-effective alternative to deep learning-based solutions, its accuracy is comparatively lower, particularly in handling complex scenarios. The research serves as an introductory framework for implementing machine learning in crime detection and highlights the potential of integrating advanced techniques to improve system performance.

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[7]This paper introduces Deep Vigilante, a deep learning-based system for detecting real-world crimes such as assaults, vandalism, and shootings. The authors utilize 3D convolutional neural networks (CNNs) for spatiotemporal analysis of video sequences. The system achieves notable success in detecting specific violent actions but lacks flexibility to adapt

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to new or unexpected behaviors. The study's strength lies in its detailed approach to action recognition, offering a solid foundation for future research. However, it requires extensive labeled datasets for training, making scalability a challenge.

[8]This research focuses on detecting gunshot sounds in indoor environments and notifying authorities in real time. The system combines acoustic signal processing and deep learning models to achieve high accuracy under controlled conditions. The authors highlight the system's ability to identify gunshot sounds amidst background noise but acknowledge sensitivity issues in environments with overlapping acoustic signals. The paper provides a promising solution for improving response times to shooting incidents, emphasizing the importance of noise-resilient models for broader applications.

[9]This study evaluates the performance of anomaly detection systems deployed on NVIDIA Jetson edge devices. The authors utilize unsupervised learning models like autoencoders to detect anomalies in video streams. The system demonstrates efficient processing on low-power devices, making it suitable for real-time crime detection in resource-constrained environments. However, the limited accuracy of unsupervised methods compared to supervised approaches poses a challenge. The paper contributes to the development of scalable and energy-efficient surveillance systems for smart cities.

[10]This paper investigates real-time recognition of violent actions such as fighting, slapping, and kicking from video footage. The authors use a combination of 2D and 3D convolutional neural networks (CNNs) to analyze temporal and spatial features. The system demonstrates high accuracy in detecting specific actions but struggles with subtle or ambiguous behaviors. The research emphasizes the importance of action recognition in crime detection and highlights the need for lightweight models to facilitate deployment in real-time scenarios.

[11]This paper presents a traffic surveillance system designed to detect stolen or suspicious vehicles using deep learning techniques. The authors implement vehicle recognition models and anomaly detection algorithms to analyze video feeds from traffic cameras. The system achieves 87% accuracy but is heavily dependent on clear license plate visibility and favourable weather conditions. The research is a significant step toward enhancing traffic security, though future work should address challenges related to low-quality footage and adverse conditions.

[12]While primarily focused on detecting structural cracks, this paper discusses the implementation of deep learning on embedded systems, offering insights applicable to crime detection. The authors fine-tune a deep belief network for anomaly detection in images. The system is effective in identifying irregularities but lacks crime-specific adaptations. The study highlights the potential of deploying lightweight models on portable devices for real-time analysis.

[13]This article provides an overview of AI applications in video surveillance, focusing on advancements like deep learning and edge computing. The discussion includes methods for crime detection, such as behavioral analytics and anomaly detection. While the article lacks specific implementations, it offers valuable insights into the potential of AI to transform surveillance systems. It serves as a primer for researchers exploring AI-driven security solutions.

[14]The paper highlights the Commonwealth Bank of Australia's implementation of an AI-driven crime alert system for financial crimes. The system integrates machine learning and rule-based approaches to streamline alert processing and reduce response times. While focused on financial crimes, the methodology has potential applications in broader crime detection contexts. The study underscores the importance of integrating AI into security frameworks for improved efficiency and accuracy.

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## III. CONCLUSION

Based on this survey we are developing a new deep learning based for Crime detection of video surveillance cameras is introduced. One advantage of this method is the use of deep learning techniques in all train and detection components. The two main components of this method are evaluated based on some metrics and with UCSD dataset which is the most famous crime detection dataset. Another benefit of this method is the isolation of train network phase. So it can use as a pre-train Network in similar works.

For further improvement, it is possible to add a component which can add descriptions to each detection classifier or to the last one; or it is possible to add a component in the detection phase which can localize the crime accurately.

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